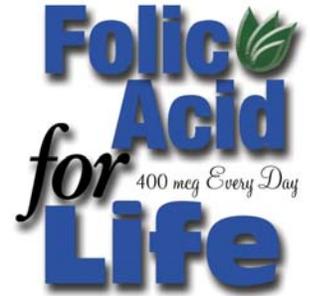




Indiana State
Department of Health



Teacher's Guide

Folic Acid for Life: Education in the Classroom

A Lesson Targeted for Middle School Students

This lesson plan was adapted with permission from the CDC Folic Acid Excite Module found at <http://www.cdc.gov/ncbddd/folicacid/excite/>

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Folic Acid for Life: Education in the Classroom

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Standards

Family and Consumer Sciences:

- 1.2 Develop healthy decision-making skills that promote positive growth & development across the life span.
- 1.4 Demonstrate nutrition and wellness practices that enhance individual and family well-being.
- 3.1 Demonstrate skills needed for self care of individuals and families, including self-responsibility and self-protection.

SCANS

- Acquires and evaluates information.
- Understands complex interrelationships and systems.

Science

- 6.4.11 Describe that human beings have body systems for obtaining and providing energy, defense, reproduction, and the coordination of body functions.

Lesson 1 (Part A and B)
(Total Estimated time 40 minutes)

Objective: Recognize terms and meanings of neural tube defects.
Increase knowledge of early fetal development.

Materials Needed: Overheads, handouts, two headed zipper (optional), paper and paper clips

Part A: Introduction (Estimated time 20 minutes)

Plan: Part A of this lesson has two components and an optional third component. The two components include the birth defects information (lecture/notes) and the demonstrations. It works best to use the demonstrations while discussing the birth defects information. The optional third component is a student activity.

Information for lecture/notes: Neural Tube Defects (NTDs) are birth defects of the brain and the spinal cord. They occur when the neural tube, which later becomes the brain and the spine, fails to close properly. This happens very early in pregnancy, between the 17th and the 28th day after conception. Often a woman doesn't even know she is pregnant at this time. After the egg and the sperm unite, cells divide and multiply to form an elongated structure as seen in day 22 (overhead pg. 6). As development progresses, a groove occurs, and tissue begins to fold over into a tube. A "zippering" effect closes the groove or the tube beginning in the center and going both up and down as seen in day 23 (overhead pg. 6). A defect may occur in the upper or lower portion of the neural tube. If the tube fails to close properly on the upper portion of the neural tube, a brain defect called anencephaly or another called encephalocele occurs (upper arrow on Day 22 overhead pg. 6). If it fails to close properly along the lower portion, a spinal defect called spina bifida occurs (lower arrow on Day 22 overhead pg. 6). In the United States, it is known that 1 of every 1,000 babies is born with a neural tube defect. (This means that on average for every 1,000 babies born, one is born with a NTD).

Demonstrations:

- 1) Overhead of Day 22 and Day 23 in embryonic development (pg. 6)
- 2) A two-headed zipper (that starts in the middle and closes at both ends) could be used to demonstrate the closing of the neural tube.
- 3) Edges of a piece of paper could be joined lengthwise to form a large tube. Several paper clips could be used to secure the edges together, from the middle toward both ends.

Both 2 and 3 show the closing of the neural tube. If the bottom of the "tube" doesn't close completely it can cause spina bifida. If the top of the "tube" doesn't close it could cause anencephaly.

Activity: Number 3 above also works well as a student activity.

Part B: Birth Defect Vocabulary (Estimated time 20 minutes)

Plan: Part B of this lesson has three components, which include the information (vocabulary words), some demonstrations and an activity. The demonstrations work in conjunction with the vocabulary words and the activity. The activity is completed after introducing the vocabulary words. The handout should be given to the students before you begin.

Vocabulary Words:

Anencephaly (Overhead included)
Conception
Embryo
Encephalocele (Overhead included)
Spina Bifida (Overhead included)
Spinal Cord
Neural Tube
Neural Tube Defect

an-en-ceph-a-ly

A fatal birth defect that happens when the neural tube does not fully close at the top. As a result, the skull and brain do not form properly. Babies with anencephaly die before or shortly after birth.

con-cep-tion

The process of becoming pregnant involving fertilization or implantation or both.

em-bry-o

An unborn baby from the beginning of pregnancy through the first 8 weeks.

en-ceph-a-lo-cele

A birth defect that is often fatal. Part of a baby's skull does not form properly, and part of the brain is outside of the skull. Previously, those babies who did survive had severe physical and mental disabilities. Today, their outcomes are generally better.

Encephalocele and the other rare neural tube defects (such as craniorachischisis) account for approximately 10% of all neural tube defects.

spi-na bi-fi-da

A birth defect of the backbone and spinal cord that leaves the spinal cord exposed. A person with spina bifida may have problems going to the bathroom because of lack of bowel and bladder control, and usually needs crutches or a wheelchair to get around. Eighty to 90% of babies with spina bifida survive, and most lead productive lives.

spin-al cord

A long tube of nerve tissue inside the bony spinal column, running from the brain down the length of the back. It controls movement and feeling.

neu-ral tube

The tube along the back of an embryo which later becomes the spinal cord and brain.

neu-ral tube de-fect (NTD)

Problems in the growth of the spinal cord and brain in an embryo, when the neural tube doesn't close at the top (anencephaly) or the bottom (spina bifida). The defects occur in the first month of pregnancy, before most women know they are pregnant. About 7 babies are born in the U.S. each day with these birth defects.

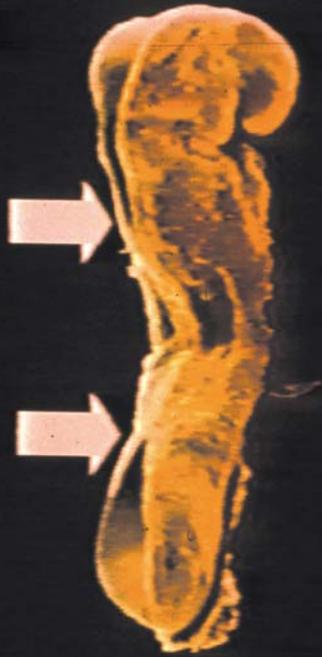
Demonstration:

- 1) You might want to use the vocabulary page to create an overhead (pg. 7).
- 2) Overheads of anencephaly, encephalocele, and spina bifida (pgs 8-10).
- 3) Handout and Overhead of blank concept map (pg. 12)

Activity: To reinforce the basic concepts, utilize the birth defects concept map (answer key pg. 11, blank map pg.12). Have students write the vocabulary words in the correct sequence on their own concept maps. Might use the bottom portion of the handout for students to write definitions. They will be able to keep these maps to remind them of vocabulary definitions and to add more information later.

If you do not include this activity in your lesson, you might want to create a handout of the vocabulary words (pg. 7).

DAY 22



Just one day before the neural tube begins to close in a zipper like fashion from the middle toward the end.

DAY 23



The embryo curves and the back portion is rolled into the neural tube. The lower end becomes the spine and the upper end becomes the brain.

Birth Defects Vocabulary

an-en-ceph-a-ly

A fatal birth defect that happens when the neural tube does not fully close at the top. As a result, the skull and brain do not form properly. Babies with anencephaly die before or shortly after birth.

con-cep-tion

The process of becoming pregnant involving fertilization or implantation or both.

en-ceph-a-lo-cele

A birth defect that is often fatal. Part of a baby's skull does not form properly, and part of the brain is outside of the skull. Previously, those babies who did survive had severe physical and mental disabilities. Today, their outcomes are generally better. Encephalocele and the other rare neural tube defects (such as craniorachischisis) account for approximately 10% of all neural tube defects.

hy-dro-ceph-a-lus

An abnormal amount of fluid in the brain. Approximately 80% of babies born with spina bifida have hydrocephalus.

spi-na bi-fi-da

A birth defect of the backbone and spinal cord that leaves the spinal cord exposed. A person with spina bifida may have problems going to the bathroom because of lack of bowel and bladder control, and usually needs crutches or a wheelchair to get around. Eighty to 90% of babies with spina bifida survive, and most lead productive lives.

spin-al cord

A long tube of nerve tissue inside the bony spinal column, running from the brain down the length of the back. It controls movement and feeling.

neu-ral tube

The tube along the back of an embryo which later becomes the spinal cord and brain.

neu-ral tube de-fect (NTD)

Problems in the growth of the spinal cord and brain in an embryo, when the neural tube doesn't close at the top (anencephaly) or the bottom (spina bifida). The defects occur in the first month of pregnancy, before most women know they are pregnant. About 7 babies are born in the U.S. each day with these birth defects.

Anencephaly occurs when the top part of the skull and the brain fail to form properly. Babies with this birth defect are miscarried, stillborn, or die shortly after birth. This birth defect is always fatal.

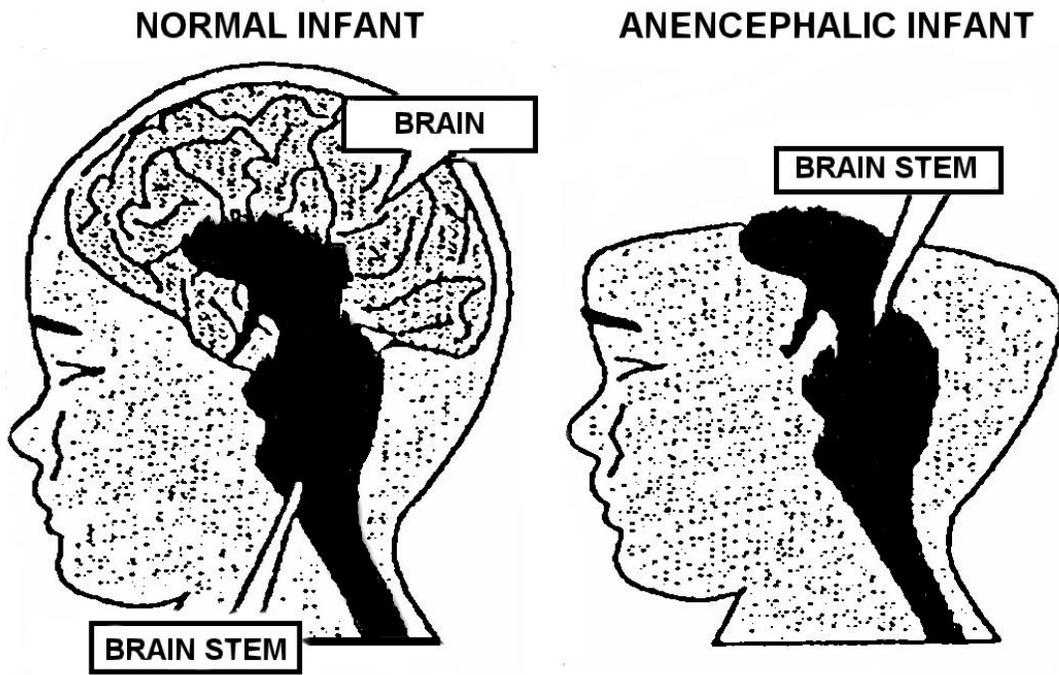


Image from: http://www.asfhelp.com/ASF_files/medical_files/Diagram-Thumbnail.htm

Encephalocele is a more rare form of neural tube defect. It occurs when the skull does not form properly, allowing part of the baby's brain to be outside the skull. Years ago, babies who survived frequently had severe mental and physical disabilities. These days, the outlook is often better.

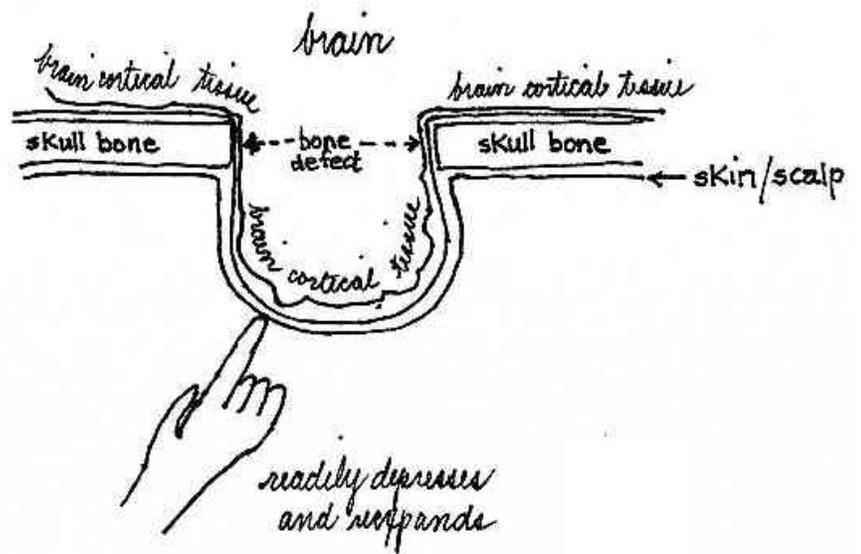


Image from <http://www.uscneurosurgery.com/.../pathology%20encephalocele.htm>

Spina bifida occurs when the spine does not form properly. An opening in the spine causes damage to the lining of the spinal column and frequently to the spinal cord itself. Often there is a sac filled with part of the spinal cord, some spinal nerves, and fluid that forms on the baby's back. The damage that occurs may lead to muscle weakness, paralysis, and loss of bowel and bladder control. Most of these babies grow into adulthood with different degrees of disabilities. Eighty to 90% of babies with spina bifida survive, and most lead productive lives.

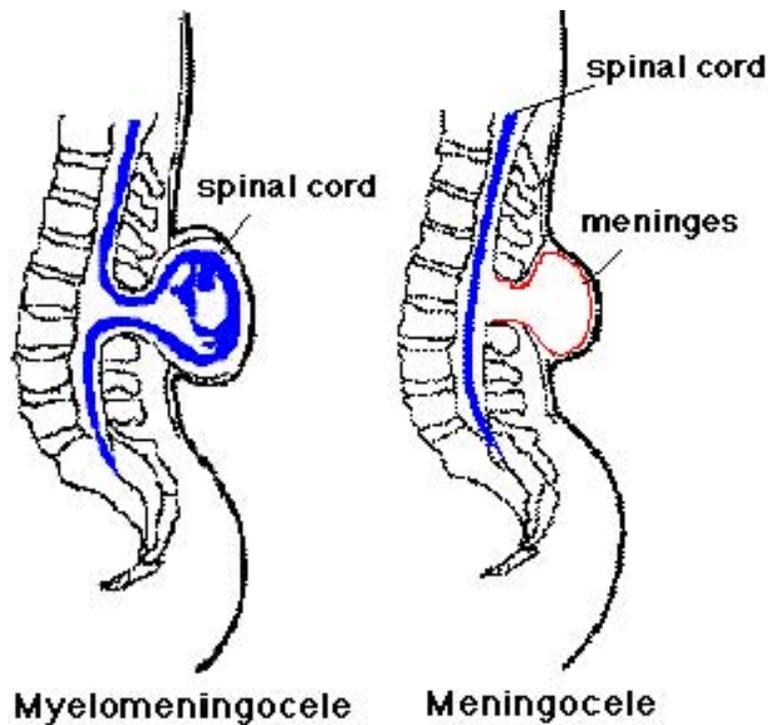
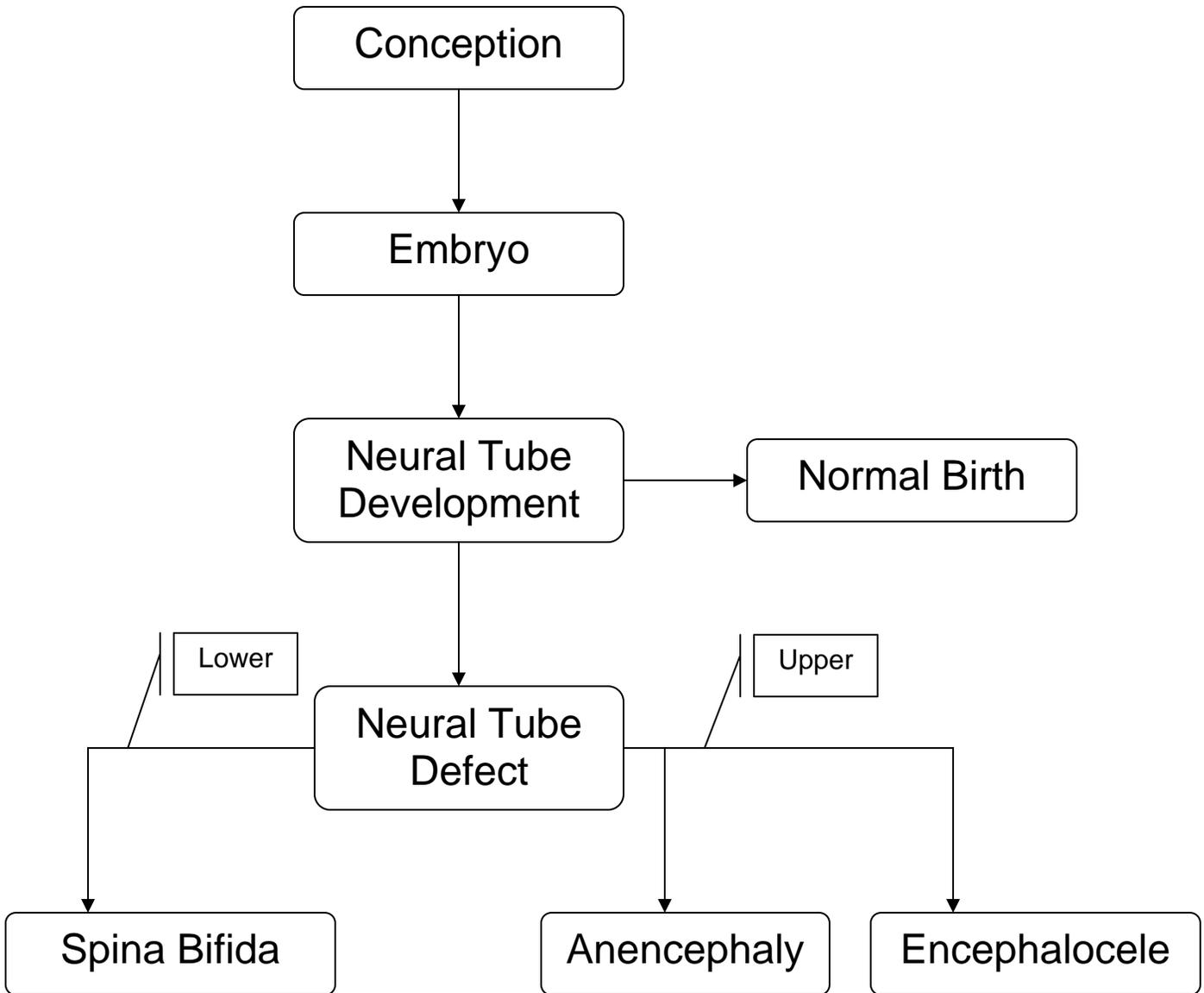


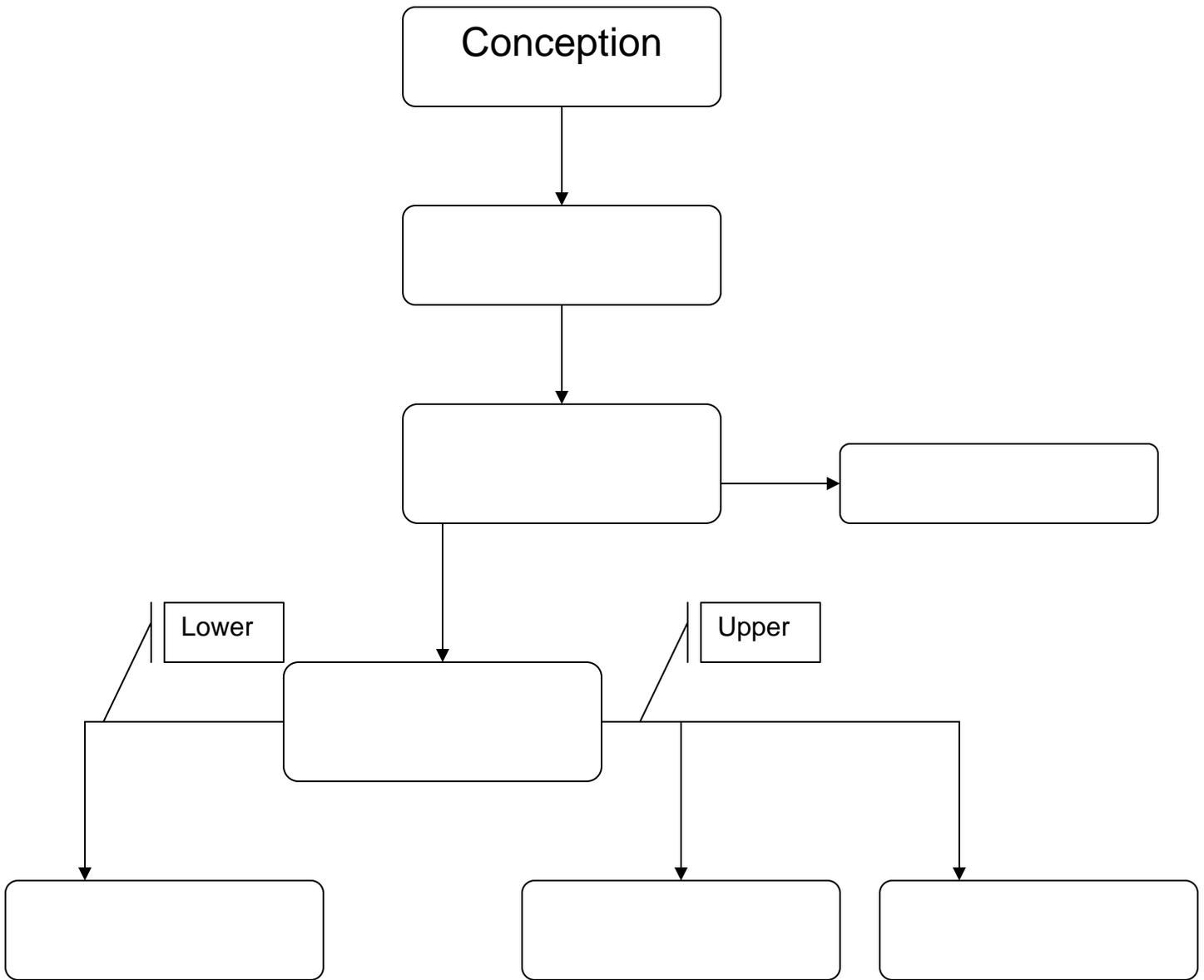
Image from: www.sbacf.org/facts_whatspina.cfm

Concept Map

ANSWER KEY



Concept Map



Fill in the concept map with the following terms:

- Anencephaly
- Embryo
- Encephalocele
- Neural Tube Defect
- Neural Tube Development
- Normal Birth
- Spina Bifida

Lesson 2: Folic Acid Information (Estimated time 40 minutes or two 20 minute sessions)

Objectives: Explain who, why and when individuals should take folic acid.
Recognize the link between folic acid, early fetal development and neural tube defects.
Understand that environmental conditions influence embryo development.
Increase knowledge about folic acid and the potential risk reduction of heart disease, certain cancers and Alzheimers Disease (students should take share this knowledge with family members).

Materials Needed: Overheads, handouts

Plan: This plan has three components, which include folic acid information (lecture/notes), a demonstration and activities. The demonstration and activity A and B are optional and can be done after discussing the folic acid information.

Information: Although the underlying biologic mechanism is unknown, researchers have found strong evidence that the B-vitamin, folic acid, can prevent 50-70% of neural tube defects like anencephaly and spina bifida.

Folic acid is a water-soluble B-vitamin. "Water soluble" means it does not stay in your body for very long (it is excreted through urine and sweat) so you need to take it every day. Folic acid and other B vitamins are needed to produce red blood cells. (Adults and children need folic acid to make normal red blood cells and prevent a certain type of anemia [*macrocytic*]). Folic acid is also necessary for the production and maintenance of DNA and RNA, the building blocks of cells. This is especially important during periods of rapid cell division and embryo development.

Based on solid evidence, in September 1992, the U.S. Public Health Service recommended "all women of childbearing age in the United States who are capable of becoming pregnant consume 400 micrograms (mcg) [0.4 milligrams (mg)] of folic acid per day for the purpose of reducing their risk of having a pregnancy affected with spina bifida or other NTDs." It is recommended that intake of folic acid not exceed 1,000 micrograms (mcg) per day.

[1 Gram = 1,000 milligrams = 1,000,000 micrograms (a microgram is a very, very small amount)]

Other Benefits. Researchers are looking at other advantages of folic acid besides preventing birth defects. Some research has found that folic acid may help prevent some heart disease, strokes, Alzheimer's disease, and some cancers (such as colon cancer) later in life. Folic acid and other B vitamins help break down homocysteine in the body. Too much homocysteine is related to heart disease, strokes and Alzheimer's disease. Since folic acid is involved in the synthesis, repair and functioning of DNA, a deficiency of folic acid may result in damage to DNA that leads to cancer.

There are two different forms of folic acid:

Synthetic form. This form is man-made. It is the form of the vitamin that is added to most multivitamin pills and **enriched** grain products, including most cereal, bread, rice, and pasta. Our bodies absorb the synthetic form of folic acid

more easily than the natural form (called folate). About 35 cereals are **fortified** with 100% (400 mcg) folic acid **per serving**. (Handout pg. 16)

Enriched means adding back nutrients that were lost during food processing (for example, natural B vitamins).

Fortified means adding nutrients that weren't present originally (for example, man-made folic acid).

Natural form. This form, called folate, is found naturally in foods such as dark-green leafy vegetables (spinach, collard greens, turnip greens, and romaine lettuce), broccoli, asparagus, beans, peanuts, strawberries, kiwi, liver, orange juice, and other food items. A diet rich in folate is important, however the average American diet does not supply enough folic acid.

Source: Institute of Medicine. Report of the Institute of Medicine Food and Nutrition Board, Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Washington, DC: National Academy Press, 1998.

Fortifying the food supply

Recognizing the importance of folic acid in preventing neural tube defects, the FDA ruled that starting January 1, 1998, all cereals and grain products labeled "enriched" must be fortified with folic acid. These foods were chosen for fortification with folic acid because they are staple products for most of the U.S. population, and because they have a long history of being successful vehicles for improving nutrition to reduce the risk of classic nutrient deficiency diseases.

Since fortification began there has been a 31% decrease in spina bifida and a 16% decrease in anencephaly. *Source: US Food and Drug Administration. 21 CFR Parts 136, 137, and 139. Food standards: amendment of standards of identity for enriched grain products to require addition of folic acid. Federal Register 1996; 61:8781-97; Williams et al (2002), Teratology 66:33-39*

Still, most people do not get enough folic acid every day. To get enough folic acid through enriched foods every day you would need to eat a whole loaf of bread; or four servings of many cereals; or 3.5 servings of pasta; or 10 servings of rice.

The average daily intake of folate from foods is about 200 micrograms. Since folate is a more complex form of folic acid, it is not absorbed and used by the body as well as folic acid. It is estimated that only one half of the folate consumed is usable. So, of the 200 micrograms that are eaten, only about 100 micrograms are actually used by the body. In addition, the folate in foods can also be lost through processing and cooking which reduces the amount of available folate even further. Since it is hard to get enough folate from foods, the Institute of Medicine states that any female who can get pregnant should take 400 micrograms of folic acid everyday from supplements or enriched foods in addition to a healthy, varied diet.

Behavior Change

1. Take a multivitamin containing folic acid everyday.
2. Eat foods fortified with synthetic folic acid.
3. Eat foods rich in food folate.
4. Tell a friend or family member about the importance of folic acid.

Activities:

A) Create a plan for 1 day's meals that includes 400 micrograms of folic acid (without eating a cereal with 400 mcg of folic acid per serving). To find the amount of folic acid in foods go to the U. S. Department of Agriculture site at http://www.nal.usda.gov/fnic/cgi-bin/nut_search.pl.

B) Design an educational poster or newspaper article to tell people about folic acid.

Example topics:

- The importance of folic acid and the development of neural tube defects
- The importance of folic acid and the possible reduction of heart disease, stroke, certain cancers, and Alzheimer's disease.
- Teen girls, women of childbearing age, and the need for folic acid
- Fortification and supplementation of foods with folic acid

CEREALS THAT CONTAIN 100% OF THE DAILY VALUE (DV) OF FOLIC ACID

The following list of cereals are fortified with 100% of the DV of folic acid per serving.

General Mills Harmony®
General Mills Multi-Grain Cheerios®
General Mills Total® Brown Sugar and Oat
General Mills Total® Corn Flakes
General Mills Total® Raisin Bran
General Mills Total® Whole Grain
Kashi® Heart to Heart
Kellogg's® All-Bran® Original
Kellogg's® All-Bran® with Extra Fiber
Kellogg's® All-Bran® Bran Buds®
Kellogg's® Complete® Oat Bran Flakes
Kellogg's® Complete® Wheat Bran Flakes
Kellogg's® Crispix®
Kellogg's® Healthy Choice™ Almond Crunch with Raisins
Kellogg's® Healthy Choice™ Low-Fat Granola with Raisins
Kellogg's® Healthy Choice™ Low-Fat Granola without Raisins
Kellogg's® Healthy Choice™ Mueslix
Kellogg's® Healthy Choice™ Toasted Brown Sugar Squares
Kellogg's® Just Right® Fruit and Nut
Kellogg's® Product 19®
Kellogg's® Smart Start®
Kellogg's® Special K®
Kellogg's® Special K® Plus™
Nature's Path Organic Optimum Power Breakfast Cereal
Quaker Oats Cap'n Crunch Red box®
Quaker Oats Cap'n Crunch with Crunch berries®
Quaker Oats Cap'n Crunch's Oops! All Berries®
Quaker Oats Cap'n Crunch's Peanut Butter Crunch®
Quaker Oats Crunchy Corn Bran®
Quaker Oats King Vitamin®
Quaker Oats Life Cereal®
Quaker Oats Life® Cinnamon
Quaker Oats Life® Honey Graham
Quaker Oats Oat Bran RTE®
Quaker Oats Oatmeal Squares®
Quaker Oats Toasted Oatmeal® - Regular flavor and Honey Nut

Name: _____

Summary Quiz:

1) **Folic acid is a:**

- a. B vitamin
- b. Form of vitamin C
- c. Substitute for vitamin E
- d. Mineral

2) **How much folic acid should you take?**

- a. 4 (mcg) micrograms of folic acid daily
- b. 40 (mcg) micrograms of folic acid daily
- c. 400 (mcg) micrograms of folic acid daily
- d. 4000 (mcg) micrograms of folic acid daily

3) **All of the following are ways to be sure that you are getting enough folic acid everyday EXCEPT:**

- a. Take a multivitamin with folic acid
- b. Eat a bowl of cereal with 100% of the DV (Daily Value) of folic acid
- c. Take a folic acid supplement
- d. Eat a cup of broccoli

4) **Folic acid reduces the risk for:**

- a. Spina bifida
- b. Anencephaly
- c. Neural tube defects
- d. All of the above

5) **The neural tube defects happen:**

- a. During the first month of pregnancy
- b. After the second month of pregnancy
- c. In the last months of pregnancy
- d. When the baby is born

6) **Folic Acid is:**

- a. Important during periods of rapid cell development
- b. Involved in DNA repair
- c. Prevents a type of anemia
- d. All of the above

7) **Most people get enough folic acid in their normal diet.**

- a. True
- b. False

8) **Folic acid in vitamins is easier for the body to use than folate in foods.**

- a. True
- b. False

9) **Folic acid may prevent all EXCEPT:**

- a. Heart disease
- b. Diabetes
- c. Stroke
- d. Certain cancers

10) **Now that you are an expert on folic acid, you should:**

- a. Make sure to take a multivitamin containing folic acid everyday
- b. Eat foods rich in folate, and foods fortified with synthetic folic acid
- c. Tell a friend about the importance of folic acid
- d. All of the above

Name: _____

ANSWER KEY

Summary Quiz:

1) **Folic acid is a:**

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- b. Form of vitamin C
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- a. Take a multivitamin with folic acid
- b. Eat a bowl of cereal with 100% of the DV (Daily Value) of folic acid
- c. Take a folic acid supplement
- d. **Eat a cup of broccoli**

4) **Folic acid reduces the risk for:**

- a. Spina bifida
- b) Anencephaly
- c) Neural tube defects
- d) **All of the above**

5) **Neural tube defects happen:**

- a. **During the first month of pregnancy**
- b. After the second month of pregnancy
- c. In the last months of pregnancy
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6) **Folic Acid is:**

- a. Important during periods of rapid cell development
- b. Involved in DNA repair
- c. Prevents a type of anemia
- d. **All of the above**

7) **Most people get enough folic acid in their normal diet.**

- a. True
- b. **False**

8) **Folic acid in vitamins is easier for the body to use than folate in foods.**

- a. **True**
- b. False

9) **Folic acid may prevent all EXCEPT:**

- a. Heart disease
- b. **Diabetes**
- c. Stroke
- d. Certain cancers

10) **Now that you are an expert on folic acid, you should:**

- a. Make sure to take a multivitamin containing folic acid everyday
- b. Eat foods rich in folate, and foods fortified with synthetic folic acid
- c. Tell a friend about the importance of folic acid
- d. **All of the above**

Additional Activity Suggestions:

Below are some ideas of more activities that could be used as extra credit activities, as homework assignments, or as assignments in other classes at school.

- Search the library or the Internet (see Related Sites page) to learn more about new folic acid research. Key words could include folic acid and homocysteine, colon cancer, or Alzheimer's disease.
- Write a paragraph about how you will help your family members remember to take a vitamin every day.
- Research and write an essay about the day in the life of someone with spina bifida.
- Write a letter to a friend who could become pregnant and tell her about folic acid.
- Write a letter to the editor or an article for a school newspaper or local paper to tell people about folic acid.
- Take a survey in your class about how many people take vitamins every day and how much folic acid is in the vitamins they take.
- Make a collage of pictures of good sources of folic acid and/or folate.
- Create a pamphlet about folic acid, why it is needed, and how to get enough of it.
- Bring in one article/advertisement mentioning folic acid in the press.
- Look in cabinets at home to find 10 food items that are enriched with folic acid. Make a list and bring the list to class. Using these lists:
 - Create a plan for 1 day's meals that includes 400 micrograms of folic acid (without eating a cereal with 400 mcg of folic acid per serving).
 - Of the 10 food items found at home, calculate how many items/serving of that particular item would be needed to get 400 micrograms of folic acid a day. For example, how many slices of bread would be needed for 400 micrograms of folic acid?
- Bring in labels of foods containing folic acid or bring in foods that contain folate or folic acid.
- Go to three pharmacies.
 - Look for pill bottles that have only folic acid. How much folic acid is in each pill?
 - Look for multivitamin pills with folic acid. Can you find at least four brands? How much folic acid is in each vitamin pill?

Birth Defects Related Sites:

Organizations

March of Dimes: www.modimes.org

Spina Bifida Association of America: www.sbaa.org

National Birth Defects Prevention Network: www.nbdpn.org

More information about folic acid and NTDs

CDC's Birth Defects Prevention Site: www.cdc.gov/ncbddd/folicacid

Indiana State Department of Health Folic Acid Campaign Site:
www.in.gov/isdh/programs/folicacid

Information on other birth defects

CDC's Birth Defects Prevention Site: www.cdc.gov/ncbddd/bd

CDC's Fetal Alcohol Syndrome Site: www.cdc.gov/ncbddd/fas/

National Organization on Fetal Alcohol Syndrome: www.nofas.org